PATENT ABSTRACTS OF JAPAN

(11)Publication number : 09-273436

(43)Date of publication of application : 21.10.1997

(51)Int.Cl. F02D 41/04
F02D 45/00
F02D 45/00

(21)Application number : 08-298566

(22)Date of filing : 11.11.1996

(71)Applicant : YAMAHA MOTOR CO LTD

(72)Inventor : NAKAMURA TSUNEHISA
MATSUO NORITAKA

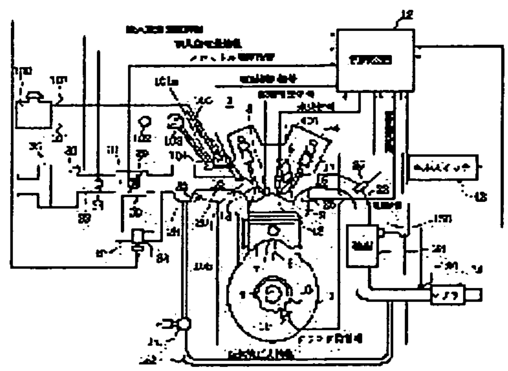
(30)Priority

Priority number : 07292644 Priority date : 10.11.1995 Priority country : JP

(54) ENGINE CONTROL METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the fuel consumption, and to reduce the exhaust gas by increasing the fuel to be supplied to an engine per one combustion cycle than the fuel supplied variable corresponding to an engine load when combustion ratio value of one or plural clank angles in the normal combustion condition is larger than the reference combustion ratio.



SOLUTION: At the time of operating an engine, output signal of an intake air temperature sensor 36, a heating coil type intake air variable sensor 34, a throttle open degree sensor 31, an intake pipe pressure sensor 32, a clank angle sensor 11 and an oxygen concentration sensor 25 or the like are taken into a control device 12, and the control device 12 controls so that the fuel to be supplied to an engine per one combustion cycle is increased, as engine load becomes larger. At this stage, a reference combustion ratio value as a fuel ratio value of one or plural predetermined clank angles in the normal fuel condition and a real fuel ratio are compared with each other, and in the case where the fuel ratio is larger than the reference fuel ratio, the fuel to be supplied to the engine per each one combustion cycle is controlled so as to be increased than the fuel supplied variable corresponding to the engine load.

LEGAL STATUS

[Date of request for examination]	13.06.2002
[Date of sending the examiner's decision of rejection]	01.05.2006
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's decision of rejection	
[Date of extinction of right]	

CLAIMS

[Claim(s)]
[Claim 1] an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load The actual combustion rate to said 1 or two or more predetermined crank angles is detected. The control approach of the engine characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load when this combustion rate consists of a criteria combustion rate size based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value.
[Claim 2] an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load The actual combustion rate to said 1 or two or more predetermined crank angles is detected. It is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate And it becomes, when that difference exceeds the specified quantity, The control approach of the engine characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load.
[Claim 3] The control approach of the engine according to claim 1 or 2 characterized by making it increase more, so that a difference becomes size according to the magnitude of the difference of said detection combustion rate and said criteria combustion rate.
[Claim 4] The control approach of the engine according to claim 1 to 3 characterized by carrying out a halt of a flame failure or fuel supply when there is no reduction of the difference more than the specified quantity or the difference of said combustion rate and said criteria combustion rate does not decrease even if it increases the quantity of said amount of fuel supply.
[Claim 5] an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches said 1 or two or more predetermined combustion rate values is detected. The control approach of the engine characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load when this crank angle precedes from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value.
[Claim 6] an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches said 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes beyond the predetermined angle

from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, The control approach of the engine characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load.
[Claim 7] The control approach of the engine according to claim 5 or 6 characterized by making it increase more, so that said include angle to precede becomes size.
[Claim 8] The control approach of the engine according to claim 5 or 6 characterized by carrying out a halt of a flame failure or fuel supply when there is no reduction of the amount of precedence include angles more than the specified quantity or the amount of precedence include angles does not decrease even if it carries out said amount loading of fuel supply.
[Claim 9] The actual combustion rate to said 1 or two or more predetermined crank angles The crank angle of a before [from after termination of an exhaust stroke / the early stages of a compression stroke], and the crank angle from compression stroke initiation to ignition initiation, The control approach of the engine according to claim 1 to 8 characterized by detecting the firing pressure in at least four crank angles which consist of two crank angles in the period from ignition initiation to exhaust stroke initiation, and making it compute based on these firing-pressure data.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the control approach of a two-cycle jump-spark-ignition engine or a four-cycle jump-spark-ignition engine.
[0002]
[Description of the Prior Art] In the two-cycle jump-spark-ignition engine or the four-cycle jump-spark-ignition engine, whenever [cylinder internal temperature] goes up according to the thermal load buildup accompanying a high revolution and a high increase in power, and possibility that abnormal combustion will happen is high. When this abnormal combustion continues, whenever [cylinder internal temperature] goes up at an increasing tempo, and there is risk of engine breakage.

[0003] For this reason, for example in the state of a heavy load, A/F is made rich, cooling in the cylinder by the fuel is performed, and there are some which prevent abnormal combustion.
[0004]
[Problem(s) to be Solved by the Invention] However, since grasp the combustion condition and it is not controlled, it is necessary to give quite big allowances to the range which performs fuel cooling. For this reason, fuel cooling is carried out beyond the need and fuel consumption is worsened.
[0005] Moreover, even if it is performing fuel cooling, abnormal combustion may happen, and there are problems, like the response at this time has not been performed enough.
[0006] For this reason, the omen to which a combustion condition is grasped and abnormal combustion happens is detected, and when it judges with a means to make it this not happen being required, and abnormal combustion having happened, a means to avert a risk is needed.
[0007] This invention aims at offering the control approach of the engine which can process appropriately and can prevent engine breakage, even when it is made in view of this point, and the preignition to which firing takes place by lifting of whenever [cylinder internal temperature] before ignition is prevented and firing has taken place before ignition.
[0008]
[Means for Solving the Problem] In order to solve said technical problem and to attain the object, the control approach of the engine invention according to claim 1 an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load The actual combustion rate to said 1 or two or more predetermined crank angles is detected. When this combustion rate consists of a criteria combustion rate size based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value, it is characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load.

[0009] Thus, the actual combustion rate to 1 or two or more predetermined crank angles is detected. It is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate When becoming, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount

of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0010] The control approach of the engine invention according to claim 2 an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load The actual combustion rate to said 1 or two or more predetermined crank angles is detected. And this combustion rate consists of a criteria combustion rate size, when that difference exceeds the specified quantity based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value, it is characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load.
[0011] Thus, the actual combustion rate to 1 or two or more predetermined crank angles is detected. It is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate And it becomes, when that difference exceeds the specified quantity, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0012] The control approach of the engine invention according to claim 3 is characterized by making it increase more, so that a difference becomes size according to the magnitude of the difference of said detection combustion rate and said criteria combustion rate.
[0013] Thus, it increases more, only when the sign of a preignition is detected, fuel cooling is performed effectively, there is no futility more, it is fuel-efficient and there is also so little blowdown of exhaust gas that a difference becomes size according to the magnitude of the difference of a detection combustion rate and a criteria combustion rate.
[0014] When there is no reduction of the difference more than the specified quantity or the difference of said combustion rate and said criteria combustion rate does not decrease even if the control approach of the engine invention according to claim 4 increases the quantity of said amount of fuel supply, it is characterized by carrying out a halt of a flame failure or fuel supply.
[0015] Thus, although the omen of a preignition is detected, the quantity of a fuel is increased and fuel cooling is performed, in order to recognize and operate this even when the effectiveness by this is not accepted, and engine breakage is prevented as a halt of a flame failure or fuel supply was carried out and the engine stopped, and the preignition has happened, engine dependability improves.

[0016] The control approach of the engine invention according to claim 5 an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches said 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, it is characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load.

[0017] Thus, a actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0018] The control approach of the engine invention according to claim 6 an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches said 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes beyond the predetermined angle from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, it is characterized by making it increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load.
[0019] Thus, a actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes beyond the predetermined angle from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0020] The control approach of the engine invention according to claim 7 is characterized by making it increase more, so that said include angle to precede becomes size.
[0021] Thus, only when the include angle to precede increases more and detects the sign of a preignition so that it becomes size, fuel cooling is performed effectively, there is no futility more, it is fuel-efficient and there is also little blowdown of exhaust gas.
[0022] When there is no reduction of the amount of precedence include angles more than the specified quantity or the amount of precedence include angles does not decrease even if the control approach of the engine invention according to claim 8 carries out said amount loading of fuel supply, it is characterized by carrying out a halt of a flame failure or fuel supply.
[0023] Thus, although the omen of a preignition is detected, the quantity of a fuel is increased and fuel cooling is performed, in order to recognize and operate this even when the effectiveness by this is not accepted, and engine breakage is prevented as a halt of a flame failure or fuel supply was carried out and the engine stopped, and the preignition has happened, engine dependability improves.

[0024] The control approach of the engine invention according to claim 9 The actual combustion rate to said 1 or two or more predetermined crank angles The crank angle of a before [from after termination of an exhaust stroke / the early stages of a compression stroke], and the crank angle from compression stroke initiation to ignition initiation, The firing pressure in at least four crank angles which consist of two crank angles in the period from ignition initiation to exhaust stroke initiation is detected, and it is characterized by making it compute based on these firing-pressure data.
[0025] Thus, the actual combustion rate to 1 or two or more predetermined crank angles is

appropriately computable based on firing-pressure data.
[0026]
[Embodiment of the Invention] Hereafter, the control approach of the engine this invention is explained to a detail based on a drawing.
[0027] Drawing 1 is a block diagram of the jump-spark-ignition type four stroke cycle engine which is two or more cylinders with which this invention is applied. This engine 1 is constituted by a crank case 2, and the cylinder body 3 and the cylinder head 4 of that upper part. In a cylinder body 3, it is equipped with a piston 7 possible [sliding] through a connecting rod 8, and the connecting rod 8 is connected with the crankshaft 9. A crankshaft 9 is equipped with the flywheel starter gear 10 which have a predetermined number of teeth, and it has the crank angle sensor 11 which serves as the engine speed sensor for detecting the revolution location of these flywheel starter gear 10, and measuring a crank angle and an engine speed. A combustion chamber 13 is formed between the cylinder head 4 and a piston 7, and the ignition plug 400 is formed so that this combustion chamber 13 may be attended.
[0028] Moreover, the combustion room pressure sensor 5 for detecting the firing pressure in a combustion chamber 13 is formed in a cylinder head 4 side. The cooling water jacket 6 is formed in the suitable location of the cylinder head 4 and a cylinder body 3. In a combustion chamber 13, a flueway 15 and the inhalation-of-air path 16 are open for free passage, and an exhaust valve 17 and an inlet valve 18 are formed in the opening, respectively. In the middle of the exhaust pipe 22 connected to the flueway 15, the catalysts 23, such as a three way component catalyst for exhaust gas clarification, are established, and the muffler 24 is formed in the edge. The oxygen density sensor (O2 sensor) 25 and the exhaust pipe temperature sensor 120 are formed in an exhaust pipe 22, and it connects with the control unit 12, respectively.
[0029] The cylinder head 4 is equipped with a temperature sensor 26, and the temperature information on a combustion chamber 13 is sent to a control unit 12. Moreover, a sensor 150 is formed in a catalyst 23 whenever [catalyst temperature / which was connected with the control unit 12]. The kill switch 43 of an engine 1 is further connected to a control device 12, and the halt information on engine drive control is acquired.
[0030] On the other hand, an inlet pipe 20 is connected to the inhalation-of-air path 16, and an inlet pipe 20 is connected with each cylinder through the inhalation-of-air distribution tube 28. The inhalation-of-air distribution tube 28 is equipped with the pressure-of-induction-pipe force sensor 32, and pressure-of-induction-pipe force information is sent to a control unit 12. The inhalation-of-air distribution tube 28 and an exhaust pipe 22 are connected, and the EGR tubing 152 is formed. The EGR regulator valve 151 connected with the control unit 12 is formed in the EGR tubing 152. An air cleaner 35 is ****(ed) by the inhalation-of-air distribution tube 28 through an inlet pipe 33. The inhalation air temperature sensor 36 is formed in an air cleaner 35, and inhalation air-temperature information is sent to a control unit 12. The inspired-air-volume regulator 30 is formed in the middle of an inlet pipe 33, and the inspired-air-volume regulator 30 is equipped with the throttle valve 29.
[0031] The throttle opening sensor 31 is formed in a throttle valve 29, and this throttle opening sensor 31 is connected with a control unit 12. The throttle-valve detour path 37 is established in the inlet pipe 33 of inspired-air-volume regulator 30 part, and the detour path opening regulator valve 38 is formed in this detour path 37. The detour path opening regulator valve 38 is connected with a control unit 12. In an inlet pipe 33, the heat ray type inhalation air content sensor 34 is formed, and inhalation air content information is sent to a control unit 12.
[0032] An injector 105 is formed in the upstream of the inlet valve 18 of the inhalation-of-air path 16 for every inlet port of each cylinder. An injector 105 is connected with a control unit 12, and the control signal of the optimal injection quantity calculated according to operational status is sent. A fuel is sent to each injector 105 through fuel pipe 101a connected with each cylinder. Fuel pipe 101a branches from the fuel distribution tube 104, it lets a fuel feeding pipe 101 pass from a fuel tank 100 to this fuel distribution tube 104, and a fuel is further sent by the fuel pump 103 through a filter 102. The fuels which were not injected from an injector 105 are collected through the fuel return pipe 107 in a fuel tank 100. A regulator 106 is formed in the fuel return pipe 107, and fuel injection pressure is kept constant.
[0033] Drawing 2 is the flow chart of the main routine which controls various engine operational

status. Each step is explained below.

[0034] Step S11: Initialization is performed and initial value is set to each flag value and each variable value.

[0035] Step S12 : The inhalation air-temperature information from the inhalation air temperature sensor 36, The inhalation air content information from the heat ray type inhalation air content sensor 34, the throttle opening information from the throttle opening sensor 31, Whenever [from a sensor 150 / catalyst temperature] Information, [whenever / pressure-of-induction-pipe force information / from the pressure-of-induction-pipe force sensor 32 / and catalyst temperature] The crank angle information from the crank angle sensor 11, the temperature information from a temperature sensor 26, The exhaust pipe temperature information from the exhaust pipe temperature sensor 120, the oxygen density information from the oxygen density sensor 25, and the oil residue information from a non-illustrated oil sensor are incorporated, and the data is memorized to memory A (i). An engine load can be grasped as an accelerator location or a throttle opening. If this throttle opening and engine speed are decided, since an inhalation air content is decided the case at the time of steady operation, an inhalation air content can be detected directly and it can be regarded as an engine load. Moreover, if an engine speed is decided, since inlet-pipe negative pressure has the fixed relation to a throttle opening, inlet-pipe negative pressure can be detected and it can be regarded as an engine load.

[0036] Step S13: Incorporate switch information, such as ON of the main switch which is not illustrated [ON of the kill switch 43, OFF and], OFF and ON of a non-illustrated starting switch, and OFF, and memorize to memory B (i). The kill switch 43 is a switch for emergency shut downs, and the engine for small marine vessels is equipped with it without preparing for the engine for cars.

[0037] Step S14: Operational status judges based on the sensor information incorporated in said step 12, and the switch information incorporated at said step 13, and input the value corresponding to the variable C in memory corresponding to this operational status **, **, **, **, **, **, **, **, **, and A**.

[0038] Operational status ** ... Beyond a predetermined value, an engine speed judges with a MBT (Minimum Advance Ignition for Best Torque) control state in the fixed accelerator condition that the rate of change of beyond a predetermined value and a throttle opening is not in the inside high-speed revolution below a predetermined value, an inside high-speed load, and a sudden acceleration-and-deceleration condition, or a ** accelerator actuation condition, and a throttle opening carries out memory of 1 to Variable C.

[0039] Operational status ** ... When the rate of change of a throttle opening is beyond a predetermined value, it judges with transient operational status and memory of 2 is carried out to Variable C.

[0040] Operational status ** ... When below a predetermined value and an engine speed are between predetermined region, for example, 1000rpm, - 5000rpm, they judge with a lean combustion control state, and a throttle opening carries out memory of 3 to Variable C.

[0041] Operational status ** ... An engine speed judges with OBAREBO more than predetermined threshold value, engine temperature judges with abnormality operational status at the time of engine abnormal conditions, such as overheat beyond a predetermined value, and memory of 4 is carried out to Variable C.

[0042] Operational status ** ... When engine temperature is below a predetermined value and a starting switch ON, it judges with a cold start condition and memory of 5 is carried out to Variable C.

[0043] Operational status ** ... At the time of a main switch OFF or the kill switch OFF, it judges with an engine shutdown demand condition, and memory of 6 is carried out to Variable C.

[0044] Operational status ** ... The time of clutch neutrality, or when an engine speed is a close by-pass bulb completely whenever [beyond predetermined value and idle switch ON, and throttle valve-opening], it judges with an idle mode and memory of 7 is carried out to Variable C.

[0045] Operational status ** ... When a switch is ON in EGR control (control the recirculation of a part of exhaust gas is carried out [control] to an inhalation-of-air system), it judges with the EGR control mode, and memory of 8 is carried out to Variable C.

[0046] Operational status ** ... When beyond a predetermined value and a starting switch are ON,

they usually judge with an engine start condition, and engine temperature carries out memory of 9 to Variable C.
[0047] Operational status A** ... When abnormality lifting of the combustion chamber internal pressure in front of jump spark ignition, the abnormalities in transition of a chamber pressure, etc. are detected from combustion room pressure data, it judges with abnormal-combustion conditions, such as a preignition condition and a knocking condition, and memory of 10 is carried out to Variable C.
[0048] Moreover, it is referred to as P= 0, when checking step S14 in a what time main routine with a flag P= 1 and exceeding the predetermined time R by the same variable C value.
[0049] At the time of C= 1, at the time of Rc=1C=2, the value of R will be set to Rc=1<Rc=2<Rc=3 by it at the time of Rc=2C=3, if the value of R changes the value of R as Rc=3.
[0050] It is referred to as P= 0 when the C value in the last main routine differs from this C value.
[0051] Step S15: Decision of being mode operation activation is performed, and in one case of 4, 6, and 9, it shifts to step S20, and Variable C shifts to step S16, in being other.
[0052] Step S16: Based on the value of Flag P, in the case of P= 0, ask for the target combustion rate according to an engine speed and a load, and put the result into Memory D with the map data in memory (thing equivalent to drawing 5). Moreover, a fundamental-points fire stage, a basic fuel-injection initiation stage, and basic fuel oil consumption are also calculated from the respectively same map data as drawing 5 in memory (what graphic-display-ized the value given as an engine speed and a function of a load), and are paid to memory E' (1), E' (2), and E' (3), respectively. Then, it is made P= 1. However, when Variable C is 5, P= 0 asks for a target combustion rate based on the target combustion rate map for cold starts, and makes Memory D memorize the value. In no cases of P= 1, it carries out, but they shift to step S17.
[0053] A combustion rate means the rate of the fuel which burned by whenever [over the fuel which burns in 1 cycle combustion / a certain crank angle]. It is the approach of asking for the chamber-pressure data in two or more points predetermined [in combustion 1 cycle] in one approach by the primary approximation about the count approach of this combustion rate, and another is the approach of calculating the amount of heat release by the thermodynamic formula from the sampled pressure value, and asking for 1 or the combustion rate to two or more predetermined crank angles (for example, top dead center). The count result with both approaches very near true value was obtained. In this case, the data of a chamber pressure detect and ask for the chamber pressure in 1 or two or more crank angles of the 1st period of a before [from after termination of an exhaust stroke / the early stages of a compression stroke]. In this case, the pressure of a combustion chamber is a crank angle in within the limits in the condition of having fallen most and having approached atmospheric pressure, for example, the crank angle of a before [from after termination of an exhaust stroke / the early stages of a compression stroke] is a bottom dead point or its near. That is, in a four stroke cycle engine, the pressure of a combustion chamber declines and atmospheric pressure is approached as are shown in drawing 6 , and the combustion gas of a combustion chamber is discharged by the exhaust stroke from the bottom dead point after explosion and a top dead center is approached. Like the inhalation line after a top dead center, the condition near atmospheric pressure is maintained for the new air conduction close, and a pressure is gradually heightened from the compression stroke after the bottom dead point where an exhaust valve 17 closes and is started through an intake stroke. The pressure of the combustion chamber in one point is detected among the range which the pressure of such a combustion chamber declined and approached atmospheric pressure. Although the crank angle a0 in drawing 6 is taken to BDC, it may be after BDC as long as it is in early stages of a compression stroke. Of course, the crank angle in the inhalation-of-air process in front of BDC is sufficient. On the other hand, with a two-cycle engine, since new mind will be introduced from a crank case if a pressure declines, the pressure of a combustion chamber will decline further according to this if an exhaust port opens, and a scavenging port opens while the piston after explosion falls, as shown in drawing 14 , atmospheric pressure is approached. After the exhaust port has opened, a piston goes up from a bottom dead point, closing, then an exhaust port increase [a scavenging port], and a **** pressure increases [****** and compression] gradually. That is, from after termination of an exhaust stroke before the early stages of a compression stroke, after a scavenging port opens after the exhaust port opened and the exhaust port has opened after exhaust air

initiation, and inhalation of air is started, between until an exhaust port closes and compression is started is said. In drawing 14 , the crank angle a0 is taken to BDC.
[0054] Jump spark ignition is performed in front of a compression backward top dead center or to the back. (Jump spark ignition is started in the crank angle expressed with an arrow head and S among drawing 6 and drawing 14 , respectively.) Jump spark ignition is started, it is slightly behind, and lights and combustion is started. The ignition initiation said by each claim is a flash when this firing combustion is started. That is, in the crank angle (drawing 14 drawing 6 , crank angle a1) of the 2nd period which is a period from compression stroke initiation to firing combustion initiation, the pressure of the **** interior of a room is detected. Then, two crank angles in the 3rd period which is a period until an exhaust stroke is started among an explosion combustion stroke from ignition initiation (firing combustion initiation) (it sets to drawing 6 and drawing 14) The pressure of a combustion chamber is detected in crank angle a2a3, the crank angles a2 and a4, the crank angles a3 and a4, the crank angles a2 and a5, the crank angles a3 and a5, or the crank angles a4 and a5. As for one crank angle, it is desirable between two crank angles in this period that it is a front [crank angle / used as the highest firing pressure]. Moreover, when the pressure of a combustion chamber detects in four or more crank angles, for example, the crank angle of five or more points, said by each claim, the number of the pressure survey crank angle points of the 1st or 2nd period may be made to increase. Moreover, in three or more crank angles, pressure detection may be carried out like [it is desirable and] the example of drawing 6 and drawing 14 [within the 3rd period]. By the diesel power plant, the fuel injection before a compression backward top dead center or to an after [a top dead center] combustion chamber is started, it is behind for a while, and combustion starts by spontaneous ignition. That is, by the diesel power plant, the ignition initiation indicated to each claim means the flash when this spontaneous ignition is started. In addition, as reach, spontaneous ignition searches for the ignition delay to initiation beforehand as an engine speed or data based on a load from fuel-injection initiation, this is woven in, it reaches and the pressure crank angle point within the pressure survey crank angle within the 2nd period and the 3rd period is memorized in memory as an engine speed or data based on a load, the pressure survey of a combustion chamber is performed.
[0055] the sum total of such 1st one period, the 2nd one period, and the 3rd two periods -- even if few, the chamber pressure of whenever [crank angle / of four points] is detected, and a combustion rate is calculated for this from a primary approximation. This approximation is combustion rate qx=a+b1*(P1-P0) +b2*(P2-P0)+... It is expressed with +bn* (Pn-P0).
[0056] As shown in a top type, to the pressure data P1-Pn, qx(es) are what applied the constant of b1-bn, and the thing which applied the constant a set up beforehand, and are expressed to what lengthened reference pressure P0 respectively.
[0057] It is what applied the constant to which C1-Cn were set beforehand, and the thing which applied the constant set up beforehand, and is expressed to that to which Pmi lengthened reference pressure P0 respectively to the pressure data P1-Pn similarly.
[0058] P0 is the chamber pressure of the point (as mentioned above for example, whenever [near the BDC / crank angle]) of atmospheric-pressure level, and in order to amend the offset voltage by the drift of a sensor etc., it is subtracted from each pressure value of P1-Pn here. Moreover, a firing pressure [in / in P1 / the crank angle a1 of the 1st period] and P2 are the chamber pressures in the crank angle a2 of the 2nd period. P3-Pn(s) are the crank angles a3-an (this example n= 5) of the 3rd period.
[0059] A value with the combustion rate actual to accuracy to the predetermined crank angle after firing and the almost same value are computed by the operation by such easy primary approximation for a short time. Therefore, while being able to take out the energy by combustion efficiently by controlling engine ignition timing and an engine air-fuel ratio using such a combustion rate, when responsibility is raised and it performs lean combustion control and EGR control, operational status can be followed exactly and output fluctuation can be suppressed. Moreover, generating of NOx by combustion advancing rapidly can be prevented. In the 2nd qx calculation approach, the heating value generated between two pressure survey points (whenever [crank angle]) the differential pressure in both the pressure survey point -- **P and a volume-of-combustion-chamber difference -- if the ratio of specific beat and R make it as an average gas constant and P0 makes amounts, such as

heat, and K the pressure value in BDC, P, and V and A the pressure value and volume-of-combustion-chamber value by the side of before [of **V and the two point of measurement] It can ask as amount Qx=Aof heat release/(K-1) * (K+1) (/2***P***V+K*(P-P0) ***V+V***P).
[0060] Moreover, the combustion rate to a predetermined pressure survey point selects a crank angle when combustion is completed mostly as a pressure survey point. It is what totaled what calculated the above-mentioned amount Qx of heat release for between [every] each pressure survey point that selected similarly the crank angle near at the time of ignition as a pressure survey point, and the meantime was measured. What totaled what calculated Above Qx about the between to a predetermined pressure survey point (predetermined crank angle) from the first pressure survey point is broken.
[0061] That is, it is heating-value x100(%) =(Q1+Q2+ ... +Qx)/(Q1+Q2+ ... +Qn) x100 of the heating value/all that burned by whenever [crank angle / of combustion rate qx= arbitration].
[0062] By the above count approaches, the chamber pressure in two or more predetermined crank angles can be measured (setting to step S112 of drawing 3), and the combustion rate to a predetermined crank angle can be computed to accuracy based on the data (setting to step S201 of drawing 7). The stable output and an engine revolution are obtained by controlling an engine using this combustion rate.
[0063] Step S17: Inhalation air-temperature information and inlet-pipe negative pressure information perform the amendment operation of the injection quantity for fuel injection. That is, since air density will become low if inhalation air temperature is high, a substantial air flow rate becomes less. For this reason, the air-fuel ratio in a combustion chamber becomes low. For this reason, the amount of amendments for reducing fuel oil consumption is computed.
[0064] Step S18: The basic fuel-injection initiation according to an engine load and an engine speed, basic fuel oil consumption, and a fundamental-points fire stage are called for at step S16, and are put in by E' (i). According to those information by which memory was carried out to the amount of amendments calculated at step S17 based on this, and memory A (i), the amount of fuel-injection amendments and the amount of ignition-timing amendments are calculated, and, in addition to a reference value, a controlled variable is calculated respectively. This controlled variable sets an ignition initiation stage to memory E (1), an ignition period is set to memory E (2), and an injection initiation stage and an injection termination stage are put into E (3) and E (4) for an injection initiation stage and an injection termination stage at F (3), F (4), and the time of P= 0 at the time of P= 1.
[0065] This is inputted into memory E (i). Similarly according to the information by which memory was carried out to memory A (i), the controlled variable of a servo motor group and a solenoid-valve group is computed, and it puts into memory G (i).
[0066] Step S19: Carry out actuation control of the actuators, such as a servo motor group and a solenoid-valve group, according to the controlled variable of memory G (i).
[0067] Step S20: An engine shutdown demand is judged, when Variable C is 6, it shifts to step S21, and in being other, it shifts to step S22.
[0068] Step S21: Set the halt data which set memory E(i) i=1-4 to 0, or carry out the flame failure of the ignition plug 400.
[0069] Step S22: Variable C judges that it is 9, when Variable C is the usual engine start of 9, shift to step S23, and when that is not right, shift to step S25.
[0070] Step S23: Set the data for making memory F (i) increase slightly the quantity of the angle of delay and fuel oil consumption for the data for start up currently beforehand put into memory, i.e., ignition timing.
[0071] Step S24: Drive a start-up motor.
[0072] Step S25: It is the case where Variable C is 4, and set the data which make the quantity of fuel oil consumption increase, extracting a throttle opening to memory F (i), if it is the data corresponding to the content of abnormalities, for example, OBAREBO, and is a flame failure and overheat.
[0073] Next, interruption routine [of drawing 3] ** is explained. This interruption routine ** will be performed by the main routine by interruption, if the crank signal of a predetermined include angle is inputted.

[0074] Step S111: Set a timer so that interruption routine ** may be performed for every predetermined crank angle, namely, so that the interrupt of whenever [following crank angle] may occur.
[0075] Step S112: Incorporate the pressure data which are whenever [crank angle / which the interrupt generated], and put into memory.
[0076] Step S113: If the pressure data of all crank angles are incorporated by memory, it will shift to step S114.
[0077] Steps S114-S115: Variable C confirms whether to be 10 or not, and, in the case of C= 10, performs and carries out the return of the abnormal-combustion prevention routine of step S115 as abnormal combustion. When that is not right, it moves to step S116.
[0078] Step S116: It confirms whether to be C= 2 and judges whether it is a transient, and it comes out so, and a transient control routine is performed by step S116a at a certain time, and it amends and carries out the return of ignition timing or A/F. Otherwise, it moves to step S117.
[0079] Step S117: It confirms whether to be C= 5, judges whether it is a cold start, and comes out so, and a cold start control routine is performed by step S117a at a certain time, and it amends and carries out the return of the ignition timing. Otherwise, it moves to step S118.
[0080] Step S118: It confirms whether to be C= 8 and judges whether it is the EGR control mode, and it comes out so, and an EGR control routine is performed by step S118a at a certain time, and it amends and carries out the return of an EGR rate or the ignition timing. Moreover, if that is not right, it will move to step S119.
[0081] Step S119: It confirms whether to be C= 3, judges whether it is lean combustion mode, and comes out so, and a lean combustion control routine is performed by step S119a at a certain time, and it amends and carries out the return of A/F or the ignition timing. Moreover, if that is not right, it will move to step S120.
[0082] Step S120: It confirms whether to be C= 7 and judges whether it is idling mode, and it comes out so, and an idling control routine is performed by step S120a at a certain time, and it amends and carries out the return of A/F or the ignition timing. Moreover, if that is not right, a MBT control routine will be performed at step S121, and the return of the ignition timing will be amended and carried out.
[0083] Next, interruption routine [of drawing 4] ** is explained. This interruption routine ** will be performed by the main routine by interruption, if a criteria crank signal is inputted.
[0084] Step S121: Since this interruption routine ** is performed once in an engine revolution and a predetermined crank angle, it measures a period.
[0085] Step S122: Calculate an engine speed.
[0086] Step S123: Set an ignition initiation stage, an ignition termination stage, an injection initiation stage, and an injection termination stage to a timer based on the control data of memory F(i) i=1-4. A timer starts an ignition and a fuel injection equipment to the set timing.
[0087] Next, the calculation of a target combustion rate explained by drawing 2 and drawing 3 is explained to a detail.
[0088] Drawing 5 is drawing of the map for asking for the criteria combustion rate or marginal combustion rate according to an engine speed and a load. It asks from what map-ized the marginal combustion rate at the time of the larger sign condition at the time of abnormal combustion than the criteria combustion rate at the time of 1 or two or more predetermined crank angles, for example, the normal combustion to a top dead center TDC, or the criteria combustion rate at the time of normal combustion, and memory is carried out to the storage of a control unit 12. The configuration of the three dimensions as which a criteria combustion rate or a marginal combustion rate is determined by a load (Lx) and the engine speed (Rx) is shown. The predetermined criteria combustion rate or predetermined marginal combustion rate in a service condition (Lx, Rx) is called for as FMB0 (Lxi, Rxi) and i=1-n.
[0089] You may make it give the criteria combustion rate or marginal combustion rate data in two or more crank angles as a criteria combustion rate or marginal combustion rate data according to operational status, for example, the criteria combustion rate of the predetermined crank angle in early stages of combustion and the predetermined crank angle of a combustion anaphase or marginal combustion rate data is given. Moreover, you may make it give the crank angle value data which

reach two or more combustion rates as crank angle value data which reach a predetermined combustion rate in case a normal combustion condition is acquired.
[0090] Drawing 6 is the graph of the chamber pressure of 1 cycle combustion of a four stroke cycle engine. As for an axis of ordinate, an axis of abscissa shows a firing pressure whenever [crank angle]. The firing pressures P0-P5 in six points of a0-a5 which whenever [crank angle] illustrated are detected, and a combustion rate is computed based on these pressure values. a0 is a bottom dead point location (BDC) which moves from inhalation to compression, and is in the condition almost near atmospheric pressure. a1 is after compression initiation and a2 is the crank angle before arriving at a top dead center (TDC) after jump spark ignition in S before jump spark ignition. Four points of a3-a5 are the crank angles which can be set like the explosion line after a top dead center. A combustion rate is computed based on the pressure data of these each point. In addition, in the case of the diesel power plant by which jump spark ignition is not carried out, a fuel is injected [near the top dead center] like FI. It is behind time to be equivalent to the crank angle after [d] injection initiation, and spontaneous ignition is carried out. The crank angle of spontaneous ignition is set to S. In this diesel power plant, control of fuel injection timing is carried out based on the difference between a target combustion rate or a target crank angle instead of control of ignition timing in an ignition spark system engine, respectively in a location survey combustion rate or a location survey crank angle. The tooth lead angle and angle-of-delay control of the injection initiation stage are carried out, and an injection termination stage is controlled so that the predetermined injection quantity is secured.
[0091] Next, the control of a combustion rate based on the calculation of a combustion rate explained by drawing 2 and drawing 3 is explained to a detail.
[0092] In step S17 of drawing 2 , an amendment operation is performed like the flow chart of the amendment operation of drawing 7 . That is, at the time of a variable C= 2, step S17 is performed, the fuel-oil-consumption amendment operation for atmospheric pressure amendment is carried out from inhalation air-temperature information and inlet-pipe negative pressure information by step S17a, the tic of the variable STATE of a transient control state is performed by step S17b, and when the variable of a transient control state is the steady state of STATE=0, transient amendment data are cleared by step S17c. In not being a steady state, it moves to step S17d, the check of a first time running state is performed [the variable of a transient control state] for the transient of STATE=1, and in being a first time running state, it moves to step S17e. Initial amendment is performed by step S17e, and stage amendment is performed at the point of the fuel-injection data at the time of acceleration and a slowdown amending [loading], and when the variable of a transient control state is STATE=2 in step S17f, it is made the first time running state of transient control.
[0093] Next, an abnormal-combustion prevention routine is shown in drawing 8 . This abnormal-combustion prevention routine is performed the whole ** cycle after an abnormality judging.
[0094] Step S251: The actual combustion rate FMB (theta) is compared with the abnormality judging combustion rate FMBMAX, and if it is equal or the actual combustion rate is larger, it will move to step S252. Otherwise, it moves to step S255.
[0095] Step S252: Add the fuel cooling correction unit CFTR by the side of loading to the fuel cooling correction value CFTX to last time, consider as the fuel cooling correction value CFTX, and move to step S253.
[0096] Step S253: The fuel cooling correction value CFTX is compared with the maximum limiting value CFTXMX of fuel cooling correction, and if the fuel cooling correction value CFTX is larger, it will move to step S254a. Moreover, if that is not right, it will move to step S254b.
[0097] Step S254a: Carry out and carry out the return of the combustion state variable DFG F to 2 (a fuel cut, ignition cut demand).
[0098] Step S254b: Carry out and carry out the return of the combustion state variable DFG F to 1 (abnormal-combustion condition).
[0099] Step S255: Lengthen the fuel cooling correction unit CFTL by the side of loss in quantity from the fuel cooling correction value CFTX to last time, consider as the fuel cooling correction value CFTX, and move to step S256.
[0100] Step S256: It judges whether the fuel cooling correction value CFTX is smaller than 0 (all seems well), and if smaller than 0 (all seems well), it will move to step S257. If that is not right, it

will move to step S258.
[0101] Step S257: Set fuel cooling correction value CFTX to 0 (all seems well), and move to step S258.
Step S258: The return of the combustion state variable DEGF is carried out and carried out to 0 (all seems well).
[0102] In this abnormal-combustion prevention control, one control of the following **s, **, **, **, **, **, **, **, and ** is performed.
[0103] first, abnormal-combustion prevention control ** -- an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load When the actual combustion rate to 1 or two or more predetermined crank angles is detected and this combustion rate consists of a criteria combustion rate size based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value, the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load. Thus, the actual combustion rate to 1 or two or more predetermined crank angles is detected. It is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate When becoming, in order to increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load, Only when the sign of a preignition is detected, fuel cooling is performed, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0104] moreover, abnormal-combustion prevention control ** -- an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load Detect the actual combustion rate to 1 or two or more predetermined crank angles, and it is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. And this combustion rate consists of a criteria combustion rate size, when that difference exceeds the specified quantity, the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load. Thus, the actual combustion rate to 1 or two or more predetermined crank angles is detected. It is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate And it becomes, when that difference exceeds the specified quantity, In order to increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load, only when the sign of a preignition is detected, fuel cooling is performed, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0105] Moreover, in abnormal-combustion prevention control ** or **, abnormal-combustion prevention control ** increases more, so that a difference becomes size according to the magnitude of the difference of a combustion rate and a criteria combustion rate. Thus, it increases more, only when the sign of a preignition is detected, fuel cooling is performed effectively, there is no futility more, it is fuel-efficient and there is also so little blowdown of exhaust gas that a difference becomes size according to the magnitude of the difference of a combustion rate and a criteria combustion rate.

[0106] Moreover, in abnormal-combustion prevention control ** thru/or **, when there is no reduction of the difference more than the specified quantity or the difference of a combustion rate and a criteria combustion rate does not decrease even if abnormal-combustion prevention control ** increases the quantity of the amount of fuel supply, it carries out a halt of a flame failure or fuel supply. Thus, although the omen of a preignition is detected, the quantity of a fuel is increased and fuel cooling is performed, in order to recognize and operate this even when the effectiveness by this is not accepted, and engine breakage is prevented as a halt of a flame failure or fuel supply was carried out and the engine stopped, and the preignition has happened, engine dependability improves.

[0107] moreover, abnormal-combustion prevention control ** -- an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load. Thus, a actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, in order to increase the quantity of the fuel per 1 combustion cycle to an engine from the amount of fuel supply according to an engine load, Only when the sign of a preignition is detected, fuel cooling is performed, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.

[0108] moreover, abnormal-combustion prevention control ** -- an engine load -- responding -- engine load size, while supplying the fuel per indeed more many 1 combustion cycles to an engine The crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes beyond the predetermined angle from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load. Thus, a actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes beyond the predetermined angle from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, Since the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load, only when the sign of a preignition is detected, fuel cooling is performed, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.

[0109] Moreover, in abnormal-combustion prevention control ** or **, it increases more and the include angle to precede depends abnormal-combustion prevention control **, so that it becomes size. Thus, only when the include angle to precede increases more and detects the sign of a preignition so that it becomes size, fuel cooling is performed effectively, there is no futility more, it is fuel-efficient and there is also little blowdown of exhaust gas.

[0110] Moreover, in abnormal-combustion prevention control ** thru/or **, when there is no

reduction of the amount of precedence include angles more than the specified quantity or the amount of precedence include angles does not decrease even if abnormal-combustion prevention control ** carries out the amount loading of fuel supply, it carries out a halt of a flame failure or fuel supply. Thus, although the omen of a preignition is detected, the quantity of a fuel is increased and fuel cooling is performed, in order to recognize and operate this even when the effectiveness by this is not accepted, and engine breakage is prevented as a halt of a flame failure or fuel supply was carried out and the engine stopped, and the preignition has happened, engine dependability improves.
[0111] Abnormal-combustion prevention control ** is set to abnormal-combustion prevention control ** thru/or **. Moreover, the actual combustion rate to 1 or two or more predetermined crank angles The crank angle of a before [from after termination of an exhaust stroke / the early stages of a compression stroke], and the crank angle from compression stroke initiation to ignition initiation, The firing pressure in at least four crank angles which consist of two crank angles in the period from ignition initiation to exhaust stroke initiation is detected, and it computes based on these firing-pressure data. Thus, the actual combustion rate to a predetermined crank angle is appropriately computable based on firing-pressure data.
[0112] Drawing 9 is drawing showing the relation between the crank angle at the time of 20 ignition timing BTDC, and the combustion rate FMB. B shows the predetermined crank angle corresponding to abnormal-combustion prevention control ** thru/or **, and A shows the predetermined combustion rate corresponding to abnormal-combustion prevention control ** thru/or **. As for 9A, in 9B, 9C shows always [forward] in the time of the elevated temperature in a cylinder at the time of the sign of a preignition at the time of preignition generating.
[0113] In abnormal-combustion prevention control ** thru/or **, if the combustion rate of the location survey in 1 or two or more predetermined crank angles (for example, B) is a1 [larger] and a2 [larger] than the combustion rate a3 of forward always, the quantity of the amount of fuel supply will be increased.
[0114] Moreover, in abnormal-combustion prevention control ** thru/or **, from the crank angle b3 of forward always, if the crank angles of the location survey which reaches 1 or two or more predetermined combustion rates (for example, A) are precedence b1 and b2, they will increase the quantity of the amount of fuel supply.
[0115] Drawing 10 is a graph which shows the relation between a crank angle and the gas temperature in a cylinder. As for 10A, in 10B, 10C shows always [forward] in the time of the elevated temperature in a cylinder at the time of the sign of a preignition at the time of preignition generating. At the time of preignition generating of 10A, in the time of the elevated temperature in a cylinder of 10B, at the time of the sign of a preignition, since the gas temperature in a cylinder is higher than always [of 10C / forward], fuel cooling is carried out and it is made low by predicting the temperature rise in a cylinder and increasing the quantity of the amount of fuel supply.
[0116] Drawing 11 is a graph which shows the relation between a crank angle and cylinder internal pressure. As for 11A, in 11B, 11C shows always [forward] in the time of the elevated temperature in a cylinder at the time of the sign of a preignition at the time of preignition generating. At the time of preignition generating of 10A, in the time of the elevated temperature in a cylinder of 10B, at the time of the sign of a preignition, since cylinder internal pressure is larger than always [of 10C / forward], fuel cooling is carried out and it is made small by predicting the pressure buildup in a cylinder and increasing the quantity of the amount of fuel supply.
[0117] Drawing 12 map-izes the marginal crank angle of the sign condition of the abnormal combustion preceded from the criteria crank angle at the time of normal combustion, or the criteria crank angle at the time of normal combustion.
[0118] That is, in drawing 12 , when the criteria crank angle which is setting to the criteria crank angle which should reach a predetermined combustion rate, or marginal crank angle CRA, and should reach an axis of abscissa at a load (L) and an axis of ordinate to a predetermined combustion rate, for example, 60%, 70%, 80 etc.%, etc., or marginal crank angle CRA0 (Rxi, Lxi) is actual engine-speed rpm (Rx) and a actual engine load (Lx), it asks from a map.
[0119] Drawing 13 is the block diagram of the two-cycle engine with which this invention is applied. Like the four stroke cycle engine of drawing 1 , a connecting rod 246 is connected with a crankshaft 241, and a combustion chamber 248 is formed between the piston at the head, and the cylinder head.

The engine speed sensor 267 and the crank angle detection sensor 268 for detecting the mark of the ring wheel with which the crankshaft 241 was equipped, and detecting whenever [reference signal and crank angle] are formed in the crank case 300. Moreover, the crank room pressure sensor 210 is formed in the crank case 300. Air is sent to a crank case 301 through a reed valve 228 from an inlet manifold. Air is sent to an inlet manifold from an air cleaner 231 through a throttle valve 204. The inhalation-of-air path of the throttle-valve downstream which is open for free passage to an inlet manifold is equipped with the pressure-of-induction-pipe sensor 211. A throttle valve 204 is operated by the grip 206 connected with the wire 205 through the throttle pulley 203. The edge of a steering handle 207 is equipped with a grip 206, and the accelerator location sensor 202 is formed in the bottom section. 212 is a throttle opening sensor.

[0120] A scavenging port 229 carries out opening to a cylinder, and a combustion chamber 248 and a crank case 301 are made to open for free passage through a scavenge air passage 252 in the predetermined location of a piston. Moreover, an exhaust port 254 carries out opening to a cylinder, and a flueway 253 is open for free passage. The flueway wall near the exhaust port is equipped with the exhaust air timing adjustable valve 264. This adjustable valve 264 is driven with the actuator 265 which consists of a servo motor etc., the opening location of an exhaust port is changed, and the timing of exhaust air is adjusted. The ******** sensor 213 and the exhaust pipe temperature sensor 223 are formed in the exhaust pipe which constitutes this flueway 253. Moreover, in a flueway, it drives with the actuator 282 with which the flueway valve 281 consists of ****, a servo motor, etc. The flueway valve 281 prevents the rat tail blow by by the low-speed area, and plans rotational stability.

[0121] A knock sensor 201 attends the cylinder head at a mounting eclipse and a combustion chamber, and it is equipped with an ignition plug 400 and the chamber-pressure sensor 200. An ignition plug is connected with ignition control equipment 256. Moreover, a cylinder side attachment wall is equipped with an injector 208. A fuel is sent to an injector 208 through the fuel delivery tubing 209.

[0122] Moreover, the combustion gas room 279 which is open for free passage into a part from exhaust air boat opening of a cylinder bore with the free passage hole 278 in the middle of the part of cylinder head approach and an exhaust port is formed in the cylinder block. This free passage hole is set up so that the combustion gas which sets like an explosion line and hardly contains blow-by gas may be introduced into the above-mentioned combustion gas room. O2 sensor 277 which detects the oxygen density in combustion gas is attached in this combustion gas interior of a room. In addition, a non-illustrated check valve is arranged at the induction of combustion gas room HE, and the blowdown section of exhaust air POTOHE, and a reverse direction flow is prevented, respectively.

[0123] Actuation control of such an engine is carried out by the control unit 257 which has CPU271. The above-mentioned chamber-pressure sensor 200, a knock sensor 201, the accelerator location sensor 202, the crank room pressure sensor 210, the pressure-of-induction-pipe sensor 211, the throttle opening sensor 212, the ******** sensor 213, the crank angle detection sensor 258, an engine speed sensor 267, and O2 sensor 277 are connected to the input side of this control unit 257. Moreover, an injector 208, the actuator 265 for exhaust air timing regulator valves, and the actuator 282 for exhaust valves are connected to the output side of a control device 257.

[0124] Drawing 14 is the same graph of a chamber pressure as the above-mentioned four stroke cycle engine and drawing 6 to show the point for combustion rate measurement of said two-cycle engine detecting [combustion pressure data]. As mentioned above, chamber-pressure data are sampled whenever [crank angle / of six points]. Within the limits of an in [drawing] A is a crank angle field as for which the exhaust port is carrying out opening, and within the limits of B is a crank angle field as for which the scavenging port is carrying out opening. How to take whenever [each crank angle] (a0-a5) and the count approach are the same on the above-mentioned four stroke cycle engine and parenchyma, are step S113 of interruption routine ** of drawing 3 , detect the firing pressures P0-P5 in six points of a0-a5 which whenever [crank angle] illustrated, and compute a combustion rate based on these pressure values. Each example of this invention can adopt what supplies combustion with a carburetor.

[0125]

[Effect of the Invention] As described above, invention according to claim 1 the combustion rate

value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load Detect the actual combustion rate to 1 or two or more predetermined crank angles, and it is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load when becoming, and the sign of a preignition is detected, in order to perform fuel cooling, There is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.

[0126] Invention according to claim 2 the combustion rate value in 1 or two or more predetermined crank angles in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria combustion rate value corresponding to a load Detect the actual combustion rate to 1 or two or more predetermined crank angles, and it is based on the comparison with the detection value of this combustion rate, and a criteria combustion rate value. This combustion rate size from a criteria combustion rate And it becomes, when that difference exceeds the specified quantity, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.

[0127] It increases more, only when the sign of a preignition is detected, fuel cooling is performed effectively, there is no futility more, invention according to claim 3 is fuel-efficient, and there is also so little blowdown of exhaust gas that a difference becomes size according to the magnitude of the difference of a detection combustion rate and a criteria combustion rate.

[0128] Although it carries out a halt of a flame failure or fuel supply, and it detects the omen of a preignition, increases the quantity of a fuel and performs fuel cooling when there is no reduction of the difference more than the specified quantity or the difference of a combustion rate and a criteria combustion rate does not decrease even if invention according to claim 4 increases the quantity of the amount of fuel supply In order to recognize and operate this even when the effectiveness by this is not accepted, and engine breakage is prevented as a halt of a flame failure or fuel supply was carried out and the engine stopped, and the preignition has happened, engine dependability improves.

[0129] Invention according to claim 5 the crank angle value which reaches 1 or two or more predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.

[0130] Invention according to claim 6 the crank angle value which reaches 1 or two or more

predetermined combustion rates in case a normal combustion condition is acquired Among a load or an engine speed, at least, while holding in memory as map data of the criteria crank angle value corresponding to a load A actual crank angle until it reaches 1 or two or more predetermined combustion rate values is detected. When this crank angle precedes beyond the predetermined angle from the criteria crank angle based on the comparison with the detection value of this crank angle, and a criteria crank angle value, Only when the quantity of the fuel per 1 combustion cycle to an engine is increased from the amount of fuel supply according to an engine load and the sign of a preignition is detected, in order to perform fuel cooling, there is no futility according to operational status, it is fuel-efficient and there is also little blowdown of exhaust gas. Moreover, since the sign of a preignition is detectable, a damage can be made an engine at the minimum, and the preignition to which firing takes place by lifting which is whenever [cylinder internal temperature] before ignition can be prevented. Moreover, since the temperature rise in a cylinder is predicted and fuel cooling is carried out, knocking can also be suppressed.
[0131] Only when the include angle which increases the quantity of more and is preceded, so that the include angle to precede becomes size increases more and detects the sign of a preignition so that it becomes size, fuel cooling is performed effectively, there is no futility more, invention according to claim 7 is fuel-efficient, and there is also little blowdown of exhaust gas.
[0132] Although it carries out a halt of a flame failure or fuel supply, and it detects the omen of a preignition, increases the quantity of a fuel and performs fuel cooling when there is no reduction of the amount of precedence include angles more than the specified quantity or the amount of precedence include angles does not decrease even if invention according to claim 8 carries out the amount loading of fuel supply In order to recognize and operate this even when the effectiveness by this is not accepted, and engine breakage is prevented as a halt of a flame failure or fuel supply was carried out and the engine stopped, and the preignition has happened, engine dependability improves.

[0133] Invention according to claim 9 can compute appropriately the actual combustion rate to 1 or two or more predetermined crank angles based on firing-pressure data.

[Translation done.]

DESCRIPTION OF DRAWINGS

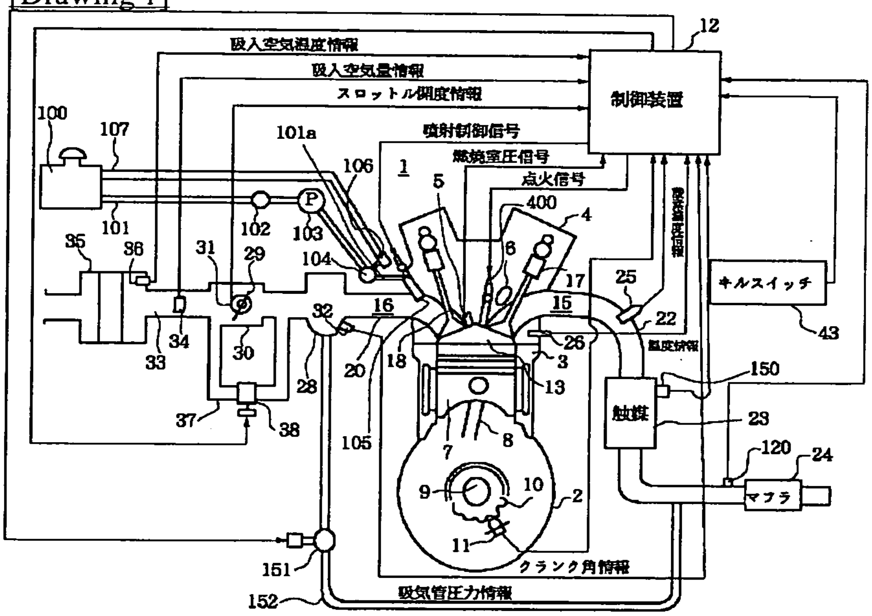
[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the jump-spark-ignition type four stroke cycle engine which is two or more cylinders with which this invention is applied.
[Drawing 2] It is the flow chart of the main routine which controls various engine operational status.
[Drawing 3] It is drawing showing interruption routine **.
[Drawing 4] It is drawing showing interruption routine **.
[Drawing 5] It is drawing of the map for asking for the criteria combustion rate or marginal combustion rate according to an engine speed and a load.
[Drawing 6] It is the graph of the chamber pressure of 1 cycle combustion of a four stroke cycle engine.
[Drawing 7] It is the flow chart of an amendment operation.
[Drawing 8] It is an abnormal-combustion prevention routine.
[Drawing 9] It is drawing showing the crank angle at the time of 20 ignition timing BTDC, the combustion rate FMB, and the relation of **.
[Drawing 10] It is the graph which shows the relation between a crank angle and the gas temperature in a cylinder.
[Drawing 11] It is the graph which shows the relation between a crank angle and cylinder internal pressure.
[Drawing 12] The marginal crank angle of the sign condition of the abnormal combustion preceded from the criteria crank angle at the time of normal combustion or the criteria crank angle at the time of normal combustion is map-ized.
[Drawing 13] It is the block diagram of the two-cycle engine with which this invention is applied.
[Drawing 14] It is the same graph of a chamber pressure as drawing 6 of the above-mentioned four stroke cycle engine to show the point for the output torque of a two-cycle engine, and combustion rate measurement detecting [combustion pressure data].
[Description of Notations]
1 Engine
9 Crankshaft
10 Flywheel Starter Gear
11 Crank Angle Sensor
12 Control Unit
13 Combustion Chamber
25 Oxygen Density Sensor (O2 Sensor)
26 Temperature Sensor
31 Throttle Opening Sensor
32 Pressure-of-Induction-Pipe Force Sensor
34 Heat Ray Type Inhalation Air Content Sensor
36 Inhalation Air Temperature Sensor
105 Injector
106 Regulator
120 Exhaust Pipe Temperature Sensor
150 It is Sensor whenever [Catalyst Temperature].

[Translation done.]

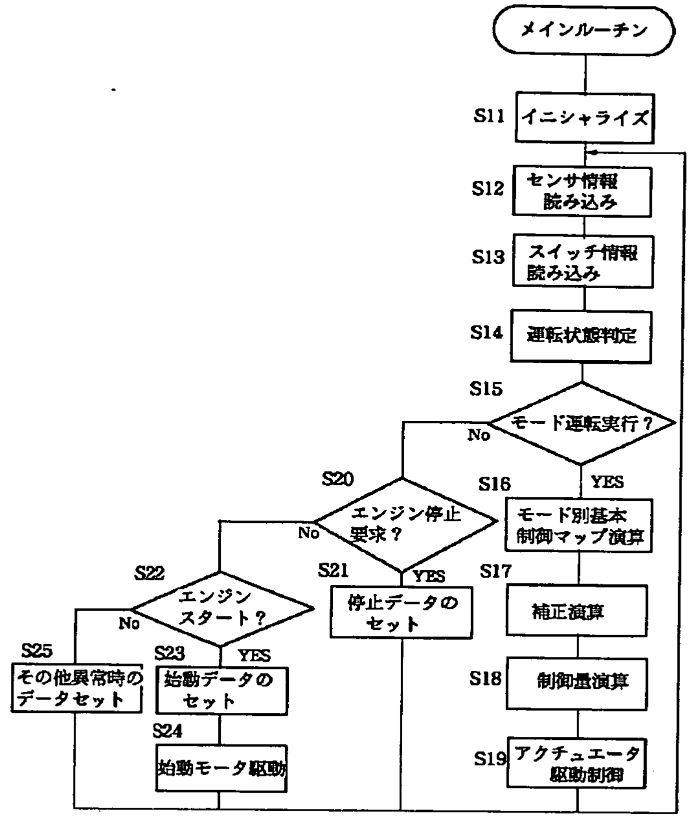
* NOTICES *

DRAWINGS

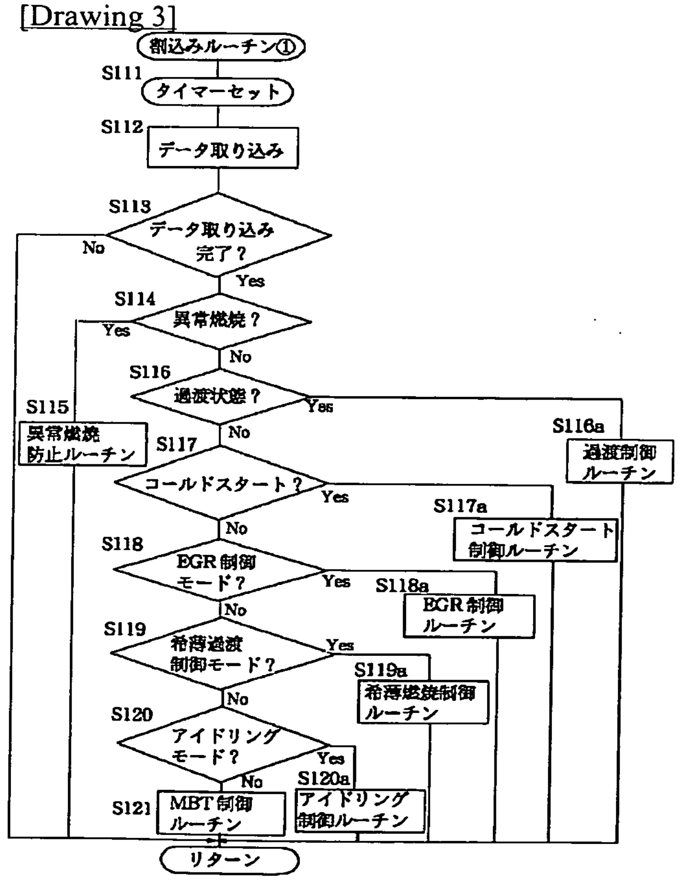
[Drawing 1]



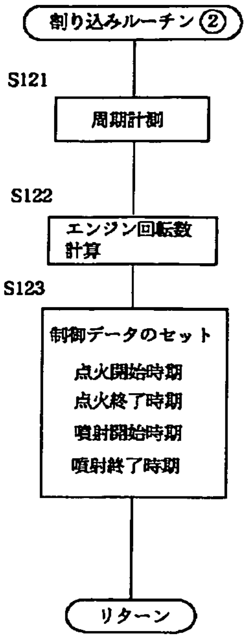
[Drawing 2]



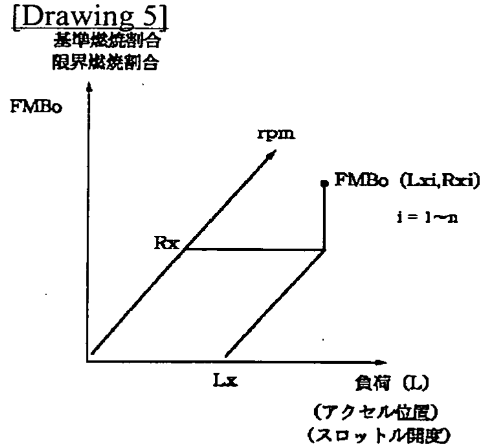
[Drawing 3]



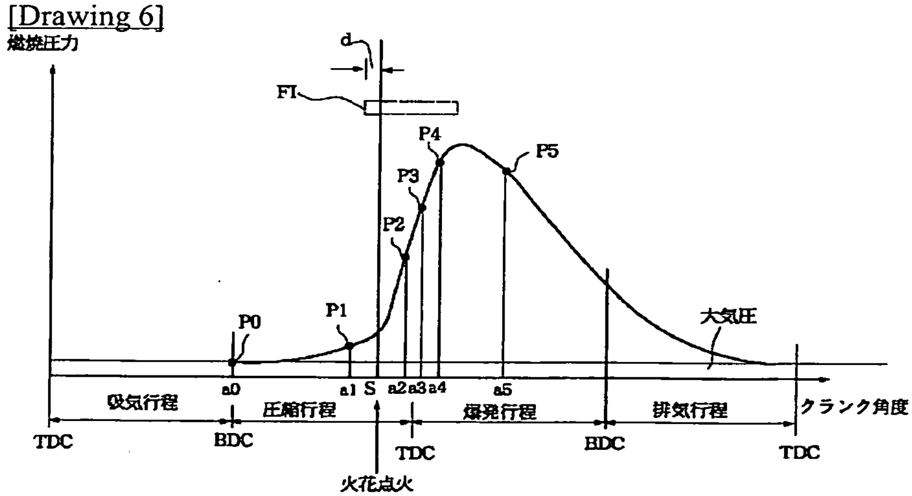
[Drawing 4]



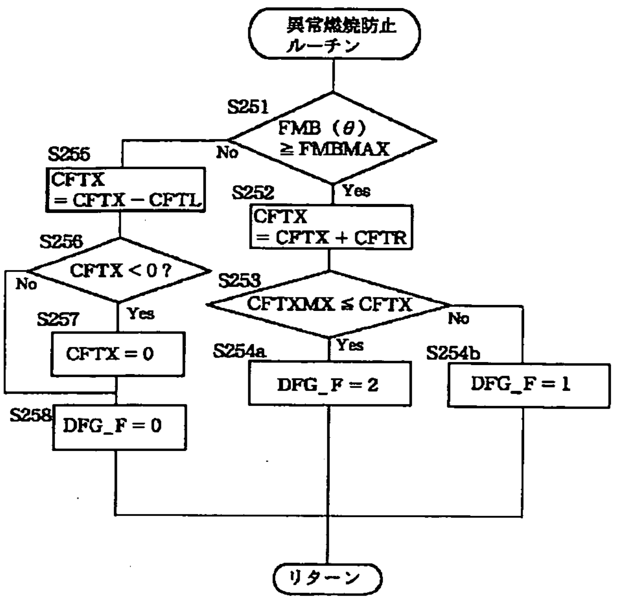
[Drawing 5]



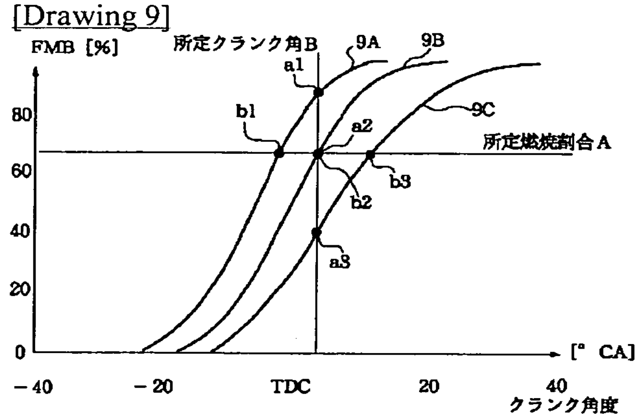
[Drawing 6]



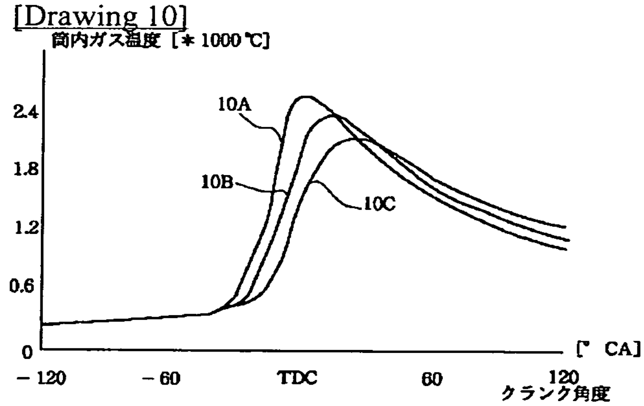
[Drawing 8]



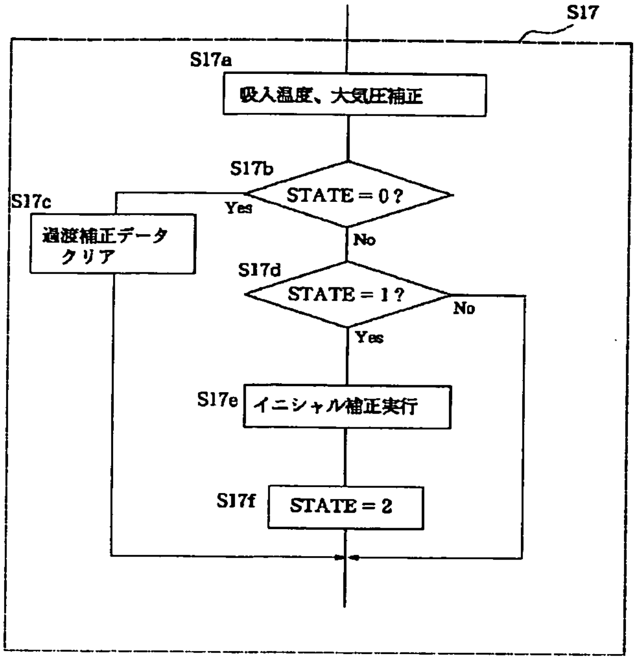
[Drawing 9]



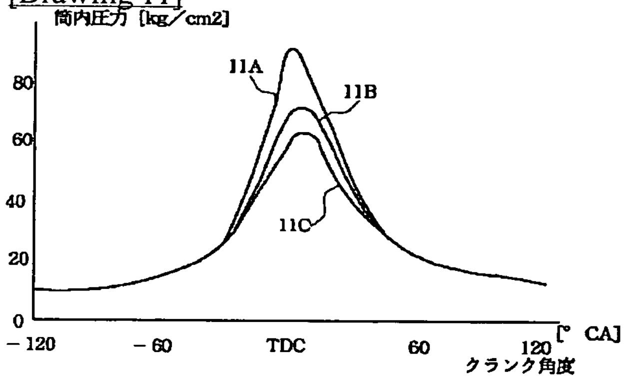
[Drawing 10]



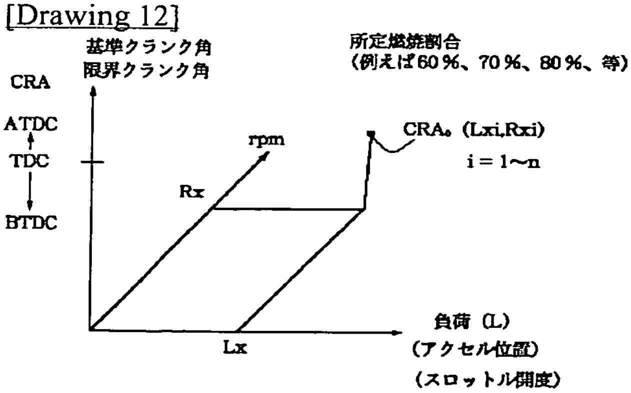
[Drawing 7]



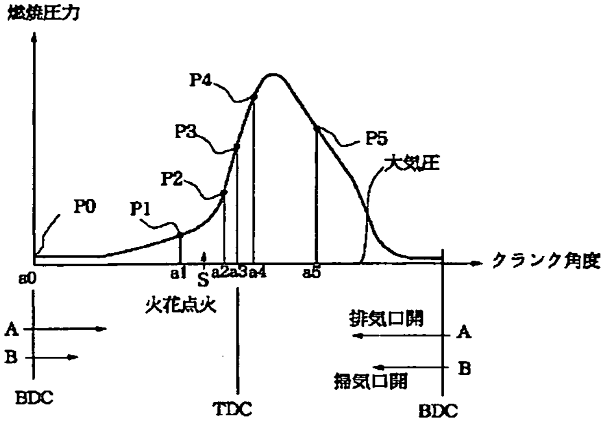
[Drawing 11]



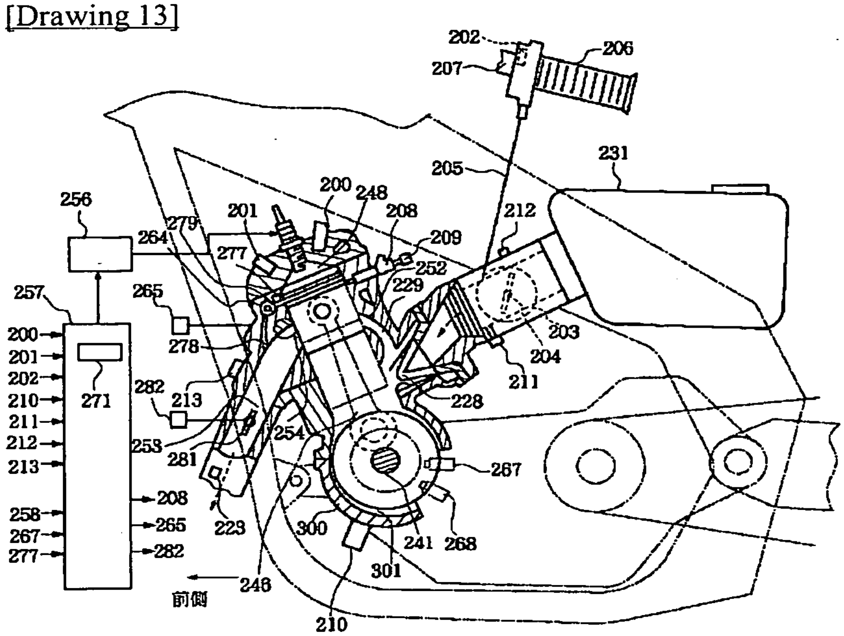
[Drawing 12]



[Drawing 14]



[Drawing 13]



[Translation done.]